Arch Argent Pediatr. 2026;e202510832

Extracorporeal membrane oxygenation as a pre-transplant rescue therapy in a patient with an oncohematological condition

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ABSTRACT

The use of extracorporeal membrane oxygenation (ECMO) in pediatrics poses a significant clinical and ethical challenges due to its high costs and associated morbidity and mortality. We present the case of a 2-year-old boy with severe bone marrow aplasia and septic shock who required ECMO as a bridge to hematopoietic stem cell transplantation. High-flow venoarterial support was initiated, initially without anticoagulation, due to marked thrombocytopenia and a high risk of bleeding. A multidisciplinary discussion was held involving the treating medical team and the institutional Ethics Committee. The patient was successfully weaned from support, showed favorable clinical progress until receiving the transplant, and achieved effective hematopoietic recovery.

This case illustrates the complexity of decision-making regarding ECMO use in oncohematological patients, highlighting the importance of individualized assessment, family involvement, and the need to avoid futile therapeutic intervention.

Keywords: *extracorporeal membrane oxygenation; blood coagulation disorders; decision-making; bone marrow transplantation; septic shock.*

doi: http://dx.doi.org/10.5546/aap.2025-10832.eng

To cite: Fraire R, Polizzi J, Castro Méndez J, Iolster T, Kreutzer C, Siaba Serrate A, et al. Extracorporeal membrane oxygenation as a pre-transplant rescue therapy in a patient with an oncohematological condition. *Arch Argent Pediatr.* 2026;e202510832. Online ahead of print 30-APR-2026.

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Funding*: None.*

Conflict of interest*: None.*

Received*: 7-25-2025*
Accepted*: 2-18-2026*

INTRODUCTION

The use of extracorporeal membrane oxygenation (ECMO) in oncohematological patients poses significant challenge. The high morbidity and mortality associated with this treatment make the decision to initiate it complex and lack clear established criteria. The presence of active malignant disease, the use of cardiotoxic medications, the risk of severe infections, and hematologic disorders such as refractory thrombocytopenia or active bleeding complicate mechanical support in this population, contributing in high mortality.

This case report describes the use of ECMO as a bridge to transplantation in a child with bone marrow aplasia, highlighting the challenges in management and illustrating the ethical dilemmas involved in the decision to initiate this type of treatment.

CLINICAL CASE

A 2-year-old patient diagnosed with bone marrow aplasia who had previously received oncohematological treatment with gamma globulin, thymoglobulin, corticosteroids, and cyclosporine, developed sepsis of abdominal origin.

The patient required mechanical ventilation (MV) and cardiovascular support with inotropes, and subsequently underwent surgery that included an ileostomy, a colostomy, debridement of the necrotic area on the abdominal wall, and management of an enterocutaneous fistula.

Blood cultures identified *Pseudomonas aeruginosa* infection, while *Candida albicans*, *P. aeruginosa,* and methicillin-resistant *Staphylococcus aureus* were isolated from abdominal wall tissue. A bone marrow aspiration confirmed the diagnosis of aplasia with specific genetic mutations (NK cell and CD19 deficiency), so it was decided to perform a bone marrow transplant.

Over the following weeks, the patient showed favorable progress, was able to be extubated without vasoactive support, and remained on parenteral nutrition while awaiting the transplant.

Suddenly, he developed septic shock that was refractory to inotropic support. Cultures were taken again, and he was treated with meropenem and vancomycin; following a team review, it was decided to initiate venoarterial ECMO support via peripheral cannulation.

Support was initiated with high flow rates (150 ml/kg/min) without anticoagulation during the first 24 hours, due to the high risk of bleeding associated with the underlying condition and persistent thrombocytopenia.

On the fifth day of support, ECMO weaning was performed, with a good response and tolerance.

Nine days after ECMO was discontinued, conditioning therapy was initiated, culminating in a hematopoietic stem cell transplant (HSCT). Ten days after the HSCT, successful engraftment was confirmed, as evidenced by an increase in white blood cell count and the recovery of the remaining hematopoietic cell lineages.

DISCUSSION

This case illustrates the difficulties inherent in the use of extracorporeal support in an extremely vulnerable population, such as critically ill hematologic-oncologic patients.[1] Its application poses significant challenges related to patient selection, anticoagulation management, and the ethical considerations involved in such an intervention.

Currently, the available evidence regarding the use of ECMO in this small and heterogeneous population, particularly in pediatric patients, is limited and inconclusive. The lack of consensus in clinical guidelines regarding the initiation of extracorporeal support complicates decision-making.[2,3] However, recent studies suggest that ECMO may be used as a rescue measure in cases of cardiogenic shock or severe respiratory failure in critically ill pediatric cancer patients, particularly following bone marrow transplantation.[4-6]

Several factors must be considered before initiating ECMO: the potential for cure of the underlying disease, effective control of infections and/or active bleeding, technical feasibility of cannulation (ruling out, for example, large-vessel thrombosis), and the patient's history of chemotherapy to assess the risks of prolonged bone marrow aplasia and cardiotoxicity.[7] In our patient, the use of ECMO was considered justified given that he had a disease potentially curable by bone marrow transplantation, thus allowing him to reach this crucial therapeutic stage. On the other hand, specific contraindications in cancer patients include a terminal prognosis, advanced metastatic disease, multiple organ failure, severe neurological compromise, or severe drug toxicity, conditions that typically contraindicate the use of extracorporeal support.[8]

Regarding hemostatic management, the

thrombocytopenia and bleeding risk inherent in these conditions there is a significant debate about the acceptable transfusion threshold. Although lacking robust evidence, the recommendations of the Extracorporeal Life Support Organization (ELSO) suggest maintaining platelet counts above 80 000 in stable patients.[9] However, achieving these levels in the oncohematological population can be extremely challenging and place significant strain on blood transfusion services due to the high consumption of blood products.

Although there is no clear evidence supporting transfusion thresholds below 50 000 platelets,[10] we opted for strict monitoring using thromboelastography (TEG) to guide individualized transfusions, maintaining platelet counts above 10 000 without heparin anticoagulation during the early stages, and using high flow rates in the ECMO circuit to minimize clot formation. This strategy is supported by the literature, which recommends avoiding heparin use during the first 24 to 48 hours when the risk of bleeding outweighs the risk of thrombosis.[11] Furthermore, maintaining high flow rates (≥150 ml/kg/min) in patients with septic shock promotes tissue perfusion and optimizes oxygen delivery, mitigating the adverse effects of high doses of inotropes on the myocardium.[12-14]

From an ethical perspective, the case raised the dilemma of balancing the provision of maximal support with recognizing when this might lead to futile medical treatment. We recognize that a truly compassionate act is not always synonymous with providing the maximum available treatment. The decision was based on a detailed assessment of the patient, who presented a sudden episode of *shock* without multisystem organ failure, with a controlled baseline condition, and awaiting transplantation. The family was actively involved throughout the process, fostering their understanding and participation in medical decisions, viewing ECMO as a bridging tool, not an end.

Limits to treatment were clearly established to avoid disproportionate interventions and to ensure an ethical framework focused on patient well-being. It must be noted that ECMO, considered a highly invasive and costly technology, while it can prolong life, also carries the risk of interfering with and unduly prolonging the final process of dying. For this reason, the team promoted frequent interdisciplinary meetings and maintained transparent, honest, and truthful communication with the family, respecting their values and their role in this complex process, recognizing that, in patients with extreme severity, there is inevitably a margin of uncertainty associated with this type of life-support therapy.

Critical complications in the treatment of pediatric oncohematological diseases pose a significant clinical and ethical challenge. In the case presented, ECMO served as an effective bridge to bone marrow transplantation. This demonstrates that, following a rigorous, multidisciplinary evaluation, this intervention can offer a real chance of recovery for carefully selected patients. ■

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